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Improvements in or relating to control apparatus for internal combustion engines

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Applicant: BRITISH UNITED TRACTION LTD;; GEOFFREY HAROLD PASSEY
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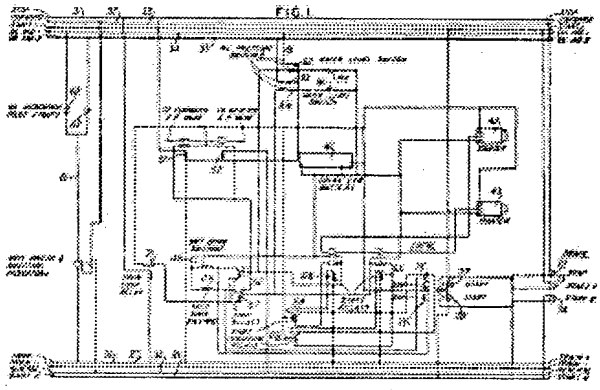
Abstract of **GB808657**

808,657. Starting prime movers. BRITISH UNITED TRACTION Ltd., and PASSEY, G. H. Jan. 7, 1957 [Oct. 18, 1955], No. 29756/55. Class 38 (4). [Also in Groups XXVII and XXXI] Apparatus for controlling a plurality of internal combustion engines comprises a plural- ity of start relays associated respectively with the engines and each connected to a common supply line, at least one starter motor for each engine, the energizing circuits for the starter motors each being controlled directly or in- directly by the associated start relay and a common start switch means for controlling the connection of the common supply line to a source of power, the arrangement being such that on operation of the common start switch means the relays cause energization of the respective starter motors to turn the respective engines. Two starter motors connected for energization simultaneously may be provided for each engine. The Figure shows apparatus for controlling diesel engines providing motive power for a railway train. The train com- prises up to six cars each of which carries two diesel engines (referred to as No. 1 and No. 2 engine respectively). The Figure shows the circuit of one car. Each car has multi-pole connectors at each end the poles of which are connected to the corresponding poles of the connectors on the adjacent cars when the train is made up. Common lines extend along each car from the poles of the connector at one end to the poles of the connector at the other end and nine of these lines are shown at 31-39 in the Figure. Each car has a battery 41 capable of providing sufficient power to energize elec- tric starter motors 42 and 43 associated re- spectively with the two diesel engines (not shown). Any one of these batteries may addi- tionally be coupled by switch means (not shown) to lines 36 and 37 on that car so that on every car lines 36 and 37 are energized. Each engine has the stopping lever of its fuel pump (not shown) controlled by a shut-down solenoid 48 or 49 which when energized moves that lever



to a position to cut-off the fuel supply to the engine so that the engine stops. When the shut down solenoid is de-energized the engine can start and run when it is turned by the associated starter motor. Two electro pneumatic valves (not shown) are provided to control through pneumatically operated pistons the direction of propulsion of each car by its engines. When the forward electro-pneumatic valve is energized the engines are coupled to the wheels to drive the car forward and when the reverse electro-pneumatic valve is energized the engines are coupled to the wheels to drive the car in reverse. The valves are controlled through forward and reverse relays 51 and 52 respectively. Two indicator lamps 62, 63 are connected to the line 61 and to the " oil indi- cator 1 " and " oil indicator 2 " lines re- spectively. The apparatus carried by the car also includes " start " relays 64, 65, " stop " relays 66, 67, start isolation relays 68, 69, a " train stop " relay 71, a " train stop " push-button switch 72, a " train start 1 " push-button switch 73 (constituting common start switch means), a " train start 2 " push-button switch 74, " local stop " push-button switch 75, 76 and " local start " push-button switches 77, 78. Two sets of contacts 81, 82, 83, 84, are provided, the first set of which is adapted to close when the lubricating oil pressure of No. 1 engine is at or above the pressure which it reaches when running and the other set of contacts is adapted to close when the oil pressure of engine No. 2 reaches such value. There are provided contacts 85, 86 associated respectively with the two engines which contacts are adapted to remain closed so long as the level of the cooling water of the engines is above a critical minimum value. Closing of contacts 81 lights the indicator lamp 62 on each car to provide an indication that engine No. 1 of the particular car whose circuit is shown in Fig. 1 is running. In the event of the oil pressure or water level of an engine falling below its proper value the appropriate contacts 82, 84 or 85 or 86 open, thereby de-energizing the appropriate stop relay 66 or 67, thus energizing the shut-down solenoid 48 or 49 to stop the engine. Either engine on each individual car may be started independently of the train control by pressing the appropriate " local start " switch button 77 or 78. The train may include additional cars not provided with engines and such additional cars may be interposed between the diesel-engine powered cars or may be equipped with positions for controlling the train, connectors being provided at each end of such additional cars and being linked by lines extending along these cars. Modified embodiments are described with reference to Figs. 2 and 3 (not shown). The train may comprise carriages, trucks or vans.

Improvements in or relating to control apparatus for internal combustion engines

Description of **GB808657**

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International Classification:-B 61 c F 02 b, d, f H 02 j.

COMPLETE SPECIFICATION

Improvements in or relating to Control Apparatus for Internal Combustion Engines We, BRITISH UNITED TRACTION LIMITED, a British Company, of Hanover House, 14, Hanover Square, London, W 1, and GEOFFREY HAROLD PASSEY, a British Subject, of 4, St George's Drive, Ickenham, Middlesex, do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement: -

The invention relates to control apparatus for internal combustion engines and it is an object of the invention to provide improved control apparatus for that purpose.

The invention provides, in one of its spects, apparatus for controlling a plurality of internal combustion engines, which apparatus comprises a plurality of relays (hereinafter referred to as start relays) associated respectively with the engines and each connected to a common supply line, at least one starter motor for each engine, the energising circuits for the starter motors each being controlled directly or indirectly by the associated start relay, and switch means (hereinafter referred to as common start switch means) for controlling connection of the common supply line to a source of power, the arrangement being such that on operation of the common start switch means the relays cause energisation of the respective starter motors to turn the respective engines The engines can thus all be started from a single control position at which common start switch means as aforesaid (e g a push-button switch) are provided.

In a preferred form of the invention a plurality of engines are mounted respectively on a plurality of cars, carriages, trucks or vans of a train (e g a railway train) and the said common supply line extends along the train.

The relays are preferably electrical relays, starter motors are preferably electrical starter motors and the said source is preferably a source of electric power.

IP Means are preferably provided for giving to a person operating the common start switch means an indication of whether or not each individual engine is running Such means may comprise for each engine an indicator lamp controlled by switch means responsive to engine oil pressure, engine speed or other condition dependent upon running of the engine.

Preferably means are provided to prevent energisation of the starter motor, or to prevent coupling between the engine and the starter motor, of any engine which is already running when the common start switch means is operated Preferably means are also provided for de-energising the starter motor, or for de-coupling from the engine the starter motor, of each engine when that engine starts to run.

Common stop control means are preferably provided for stopping all of the engines from a single control position The common stop control means preferably comprise a plurality of relays (hereinafter referred to as common stop relays or train stop relays) associated respectively with the engines and each connected to a common supply line, a plurality of fuel cut-off means for cutting off the fuel supplies to the respective engines, which fuel cut-off means are each respectively controlled directly or indirectly by the associated train stop relay and switch means (hereinafter referred to as common stop switch means) for controlling connection of the common stop supply line to a source of power, the arrangement being such that on operation of the common stop switch means the train stop relays directly or indirectly cause the fuel cut off means to cut off the fuel supplies to the engines The common start switch means and the common stop switch means are preferably provided at a common control position A plurality of such common control positions, each having common start switch means and common stop switch means, may be provided e g on each car of a train.

Means are preferably provided for starting and stopping each engine individually irrespective of the common start and stop controls Means responsive to an abnormal running condition of each engine (e g low oil pressure, low water level, or fire), may be provided for stopping that engine if such abnormal condition occurs.

Some specific constructions of apparatus embodying the invention will now be described by way of example and with reference to the accompanying drawings, in which: Figures 1, 2 and 3 are respectively circuit diagrams of three forms of apparatus for controlling diesel engines providing motive power for a railway train.

In these examples the train comprises up to six cars each of which carries two diesel engines (referred to for convenience as the No.

1 and No 2 engine respectively of each car).

Each of the Figures shows the circuit of one car.

Each car has multi pole connectors at each end, the poles of which are connected to the corresponding poles of the connectors on the adjacent cars when the train is made up.

Common lines extend along each car from the poles of the connector at one end to poles of the connector at the other end, and nine of those lines are shown at 31-39 in each of the Figures of the drawings.

Each car has a battery, 41, capable of providing sufficient power to energise electric tarter motors 42 and 43, associated respectively with the two diesel engines (not shown).

Any one of these batteries may additionally be coupled by switch means (not shown) to lines 36 and 37 on that car, so that on every car, lines 36 and 37 are energised Each engine has the stopping lever of its fuel pump (not shown) controlled by a shut-down solenoid 48 or 49 which when energised moves that lever to a position to cut off the fuel supply to the engine so that the engine stops When the shut down solenoid is de-energised the engine can start and run when it is turned by the associated starter motor Two electro-pneumatic valves (not shown) are provided to control through pneumatically operated pistons, the direction of propulsion of each car by its engines When the forward electro-pneumatic valve is energised the engines are coupled to the wheels to drive the car forward, and when the reverse electro-pneumatic valve is energised the engines are coupled to the wheels to drive the car in reverse Those valves are controlled through forward and reverse relays 51 and 52 respectively The operating coil of the forward relay 51 is connected between the "train negative " line 37 and the " forward" line 32, and the operating coil of the reverse relay 52 is connected between the " train negative" line 37 and the "reverse" line 38.

As shown in Figure 1 a direction selector switch 53 is provided and this has a movable contact 54 which may be connected through a main switch 58 to the "train positive" line 36 The direction switch has an " off " position in which the movable contact 54 is on contact 55, a "forward" position in which 70 the movable contact 54 is on contact 56 and so connects the "train positive" line 36 to the " forward " line 32, and a " reverse " position in which the movable contact 54 is on contact 57 and so connects the "train positive" line 75 to the "reverse" line 38 The movable contact 59 of the main switch 58 is ganged to the movable contact 54 of the direction selector switch 53, and the main switch connects the "train positive" line 36 to the contact 54, 80 and also to a line 61, when the direction selector is in either its forward or reverse position Two indicator lamps 62, 63 are connected to the line 61 and to the " oil indicator 1 " and " oil indicator 2 " lines respec 85 tively.

The apparatus carried by the car also includes " start" relays 64, 65, "stop " relays 66, 67 (in the case of Figures 1 and 2 only), " start isolation relays " 68, 69, a " train stop " 90 relay 71, a "train stop " push-button switch 72, a " train start 1 " push-button switch 73 (constituting common start switch means as aforesaid), a " train start 2 " push-button switch 74, " local stop " push-button switches 95 75, 76, and " local start " push-button switches 77, 78.

In addition in the circuits shown in Figures 1 and 2 two sets of contacts 81, 82 and 83, 84 are provided the first set of which is adapted 100 to close when the lubricating oil pressure of engine No 1 is at or above the pressure which it reaches when running, and the other set of which contacts is adapted to close when the oil pressure of engine No 2 reaches such a value 105 In the circuits shown in all three of the Figures there are provided contacts 85, 86, associated respectively with the two engines which contacts are adapted to remain closed so long as the level of the cooling water of the engines 110 is above a critical minimum value If the water level of one of the engines falls below that value the appropriate contacts 85 or 86 open.

The various elements of the circuits are shown in the condition which they have when 115 the engines are running normally to drive the train forward.

The operation of the circuit shown in Figure 1 is as follows Assuming that the train is stationary and it is desired to start the 120 engines to drive the train forward, the first operation is to move the ganged contacts 54, 59 of the main switch 58 and direction selector switch 53 to the positions indicated in Figure 1 The consequent connection of the 125 "forward" line 32 to the "train positive" line 36 energises the coil of the forward relay -51 on each car, closing contacts 87 and 88.

The closing of contact 87 causes the engines to be coupled to the wheels ready for the train 130 808,657 (e.g in order to try again to start the engine No 1 on another car which may have failed to start on the first depression of button 73) the " start 1 " relay associated with that particular relay 68 will not operate and cossequently the starter motor 42 of an engine which is already running will not be energised.

The sequence of events on pressing the " train start 2 " press button switch 74 to start the engines No 2 of the train is analogous to that which follows the pressing of the "train start 1 " button 73 and consequently will not be described separately.

When it is desired to run the train in reverse the direction selector switch 53 is set so that the contact 54 is on contact 57 instead of on contact 56 and in that case the reverse relay 52 is energised instead of the forward relay 51 The contacts 99 then fulfil a similar function to the contacts 88, and the contacts 101 serve to energise the reverse electropneumatic valve instead of the forward electropneumatic valve.

When it is desired to stop all of the engines of the train the " train stop " button 72 is pressed, thereby energising the " train stop" relay 71 on each car, through the " stop " line 31 The contacts 98 are thereby opened, so breaking the energising circuits of " stop" relays 66, 67 The contacts 91, 92 therefore close to energise the shut-down solenoids 48, 49, thereby stopping both engines on each car.

Either engine on any individual car may be stopped independently of the train control, by pressing the appropriate "local stop " switch button 75 or 76, thereby to energise the shut down solenoid 48 or 49 without using " train stop" relay 71, " stop 1 " relay 66, or " stop 2 " relay 67.

Either engine on each individual car may be started independently of the train control, by pressing the appropriate " local start " switch button 77 or 78 These " local start " buttons have normally closed contacts 102, which are connected respectively in series between the " start 1 " and "start 2 " lines 33, 39, and the contacts 93 of the " start isolation " relays 68, 69 and the coils of the "start" relays 64, 65, and normally open contacts 104 which are connected in series between the " train + " line 36 and the contacts 93 of the " start isolation " relays 68, 69 and the coils of the "C start " relays 64, 65 When the " local start " button 77 or 78 is pressed the contacts 108 are thereby closed to energise the appropriate " start " relay 64 or 65 and the starter motor of the appropriate engine, provided that the " train + line 36 is energised, and that the appropriate " start isolation " relay 68 or 69 is unenergised The opening of the contacts 106 when a "local start" button is pressed, prevents energisation of the " start 1 " line 33 or " start 2 " line 39 by pressing of a " local start " button If the appropriate engine is to be driven forward The closing of contacts 86 connects the positive terminal 89 of the local battery 41 to the shut down solenoids 48, 49 through the closed contacts 91, 92 of the stop relays 66, 67 The engines of all the cars are thus put into shut down condition.

The " train start 1 " button 73 is then pressed and the consequent connection of the "start 1 " line 53 to the "train positive" line 36 energises the coil of the " start 1 " relay 64 through the closed contacts 93 of " start isolation 1 " relay 68, thereby closing contacts 94 and 95 and opening contacts 96 The closing of contacts 95 connects the coil of stop 1 relay 66 between the positive and negative terminals 89, 97 of the local battery 41, through the closed contacts 98 of the "train stop " relay 71 The contacts 91 therefore open and de-energise the shut-down solenoid 48 so that the engine No 1 of each car is set to a condition ready to be started The closing of contacts 94 of the " start 1 " relay 64 connects the positive terminal of the local battery 41 to the starter motor 42, thereby energising it to turn the engine No 1 Thus the engine No.

1 on each car starts to run, provided that it is in proper working order.

The opening of contacts 96 on the "start 1 " relay 64 breaks the energising circuit of the coil of the " start isolation 1 " relay 68 to ensure that the " start isolation 1 " relay cannot be energised while the " start 1 "button is operated While the "train start 1 " button

73 is maintained pressed the oil pressure of engine No 1 on each car increases until it reaches its proper running value, whereupon the contacts 81, 82 close The closing of contacts 81 connects the "oil indicator 1 " line 34, to the "train negative" line 37 thereby lighting the indicator lamp 62 on each car, to provide an indication that engine No 1 of the particular car whose circuit is shown in Figure 1 is running The closing of contacts 82 provides an additional connection, through contacts 85, from the negative terminal 97 of the local battery 41 to the coil of the " stop 1 " relay 66, duplicating the similar feed thereto through the " start 1 " relay contacts 95, so that the " stop 1 " relay 66 remains operated even when the " start 1 " relay subsequently becomes unoperated as about to be described.

When the "train start 1 " button 73 is released the " start 1 " relay 64 on each car becomes unoperated, thereby opening contacts 94 to de-energise the starter 42, opening contacts 95, and closing contacts 96 to connect the coil of the " start isolation 1 " relay 68 to the negative terminal 97 of the local battery 41 through the closed oil pressure contacts 82 and the closed water level contacts 85 The contacts 93 of relay 68 are thus opened, so that even if the "train start 1 " button 73 is pressed again while the engine No 1 associated with that particular relay 68 is running 808,657 already running when its " local start " button is pressed, the associated " start isolation " relay is unenergised and consequently the relevant starter motor is not energised.

In the event of the oil pressure or water level of an engine falling below its proper value the appropriate contacts 82, 84 or 85 or 86 open, thereby de-energising the appropriate stop relay 66 or 67 thus energising the shut down solenoid 48 or 49 to stop the engine.

Also on the occurrence of low oil pressure the contacts 81 or 83 open so that the appropriate lamp 62 or 63 is extinguished.

In the circuit shown in Figure 2 the contacts 96 omitted from the " start " relays 64, and the coils of the " start isolation " relays are switched by contacts 102, 103 of engine speed relays 104, 105 These relays have their coils directly or indirectly connected respectively to tachometer generators driven by the two engines of the car When engine No 1 (for example) reaches a predetermined moving speed its generator causes the associated engine speed relay 104 to operate, thereby energising the " start isolation 1 " relay 68 to open its contacts 93 for the above described purpose.

In the circuit shown in Figure 3, the oil pressure contacts 81-84, and the contacts 95 and 96 of the " start" relays 64, 65 are omitted Engine speed relays are provided as in Figure 2 Stop relays 66, 67 are also omitted and the train stop relay is provided with two sets of contacts 106, 107 which serve to energise the shut down solenoids 48, 49 from the local battery 41 when the "train stop" button 72 is pressed The water level contacts 85, 86 are in this Figure, open when the water level is satisfactory When those contacts 85, 86 close they serve to energise the shut down solenoids to stop the engines.

A switch (not shown) is provided to isolate the starter of any one engine, from the local battery and " start 1 " or " start 2 " lines when desired The operation of "train start 1 " or " train start 2 " buttons or "local start 1 " or "local start 2 " buttons, will not affect an engine so isolated.

In each case each position from which the train may be controlled is equipped with a separate oil indicator lamp (such as 62, 63) for each engine of the whole train, an air and direction indicator lamp for each car (indicating that the engines on each car are coupled to drive it in the direction selected), a gear control unit comprising (a) means for changing the gear ratio of the coupling between the engines and their car wheels-four alternative gear ratios being provided for, and each gear ratio having a control line running the length of the train, and (b) a direction selector switch 53 and a main switch 58 as previously described This switch is also ganged to operate further switches which only allow oil indication lamps to indicate at a driving position from which the train is controlled at any one time, and isolates the throttle controls (mentioned below) at driving positions not being used There are also provided at each control position a throttle con 70 trol for setting the throttles of all of the engines of the train-four alternative settings being provided for and each setting having a control line running the length of the train-, a combined 'deadmans' control and emerg 75 ency valve for stopping the train in an emergency and connected to a 'deadmans' control line running the length of the train, and a passenger communication cancellation valve (for temporarily overriding an emergency 80 brake application) operated by a press button.

The circuits shown in Figures 1, 2 and 3 are particularly applicable to multi-unit trains employing diesel engines with mechanical transmission 85 The train may include additional cars not provided with engines, and such additional cars may be interposed between the dieselengine powered cars or may be equipped with positions for controlling the train, connectors 90 being provided at each end of such additional cars and being linked by lines extending along those cars.

The invention is not restricted to the details of the foregoing examples For instance addi 95 tional contacts may be provided for stopping any engine if its cooling water or lubricating oil temperature exceeds a safe value, or if an engine exceeds its safe running speed, or if a fire detection system detects a fire in an engine 100 Two starter motors, connected for energization simultaneously, may be provided for each engine.

PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in or relating to Control Apparatus for Internal Combustion Engines

We, BRITISH UNITED TRACTION LIMITED, a British Company, of Hanover House, 14, Hanover Square, London, W.1, and GEOFFREY HAROLD PASSEY, a British Subject, of 4, St. George's Drive, Ickenham, Middlesex, do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to control apparatus for internal combustion engines and it is an object of the invention to provide improved control apparatus for that purpose.

The invention provides, in one of its aspects, apparatus for controlling a plurality of internal combustion engines, which apparatus comprises a plurality of relays (hereinafter referred to as start relays) associated respectively with the engines and each connected to a common supply line, at least one starter motor for each engine, the energising circuits for the starter motors each being controlled directly or indirectly by the associated start relay, and switch means (hereinafter referred to as common start switch means) for controlling connection of the common supply line to a source of power, the arrangement being such that on operation of the common start switch means the relays cause energisation of the respective starter motors to turn the respective engines. The engines can thus all be started from a single control position at which common start switch means as aforesaid (e.g. a push-button switch) are provided.

In a preferred form of the invention a plurality of engines are mounted respectively on a plurality of cars, carriages, trucks or vans of a train (e.g. a railway train) and the said common supply line extends along the train. The relays are preferably electrical relays, starter motors are preferably electrical starter motors and the said source is preferably a source of electric power.

Means are preferably provided for giving to a person operating the common start switch means an indication of whether or not each individual engine is running. Such means may comprise for each engine an indicator lamp controlled by switch means responsive to engine oil pressure, engine speed or other condition dependent upon running of the engine.

Preferably means are provided to prevent energisation of the starter motor, or to prevent coupling between the engine and the starter motor, of any engine which is already running when the common start switch means is operated. Preferably means are also provided for de-energising the starter motor, or for de-coupling from the engine the starter motor, of each engine when that engine starts to run.

Common stop control means are preferably provided for stopping all of the engines from a single control position. The common stop control means preferably comprise a plurality of relays (hereinafter referred to as common stop relays or train stop relays) associated respectively with the engines and each connected to a common supply line, a plurality of fuel cut-off means for cutting off the fuel supplies to the respective engines, which fuel cut-off means are each respectively controlled directly or indirectly by the associated train stop relay and switch means (hereinafter referred to as common stop switch means) for controlling connection of the common stop supply line to a source of power, the arrangement being such that on operation of the common stop switch means the train stop relays directly or indirectly cause the fuel cut off means to cut off the fuel supplies to the engines. The common start switch means and the common stop switch means are preferably provided at a common control position. A plurality of such common control positions, each having common start switch means and common stop switch means, may be provided e.g. on each car of a train.

[P

Means are preferably provided for starting and stopping each engine individually irrespective of the common start and stop controls. Means responsive to an abnormal running condition of each engine (e.g. low oil pressure, low water level, or fire), may be provided for stopping that engine if such abnormal condition occurs.

Some specific constructions of apparatus embodying the invention will now be described by way of example and with reference to the accompanying drawings, in which:—

Figures 1, 2 and 3 are respectively circuit diagrams of three forms of apparatus for controlling diesel engines providing motive power for a railway train.

In these examples the train comprises up to six cars each of which carries two diesel engines (referred to for convenience as the No. 1 and No. 2 engine respectively of each car). Each of the Figures shows the circuit of one car.

Each car has multi pole connectors at each end, the poles of which are connected to the corresponding poles of the connectors on the adjacent cars when the train is made up. Common lines extend along each car from the poles of the connector at one end to poles of the connector at the other end, and nine of those lines are shown at 31—39 in each of the Figures of the drawings.

Each car has a battery, 41, capable of providing sufficient power to energise electric starter motors 42 and 43, associated respectively with the two diesel engines (not shown). Any one of these batteries may additionally be coupled by switch means (not shown) to lines 36 and 37 on that car, so that on every car, lines 36 and 37 are energised. Each engine has the stopping lever of its fuel pump (not shown) controlled by a shut-down solenoid 48 or 49 which when energised moves that lever to a position to cut off the fuel supply to the engine so that the engine stops. When the shut down solenoid is de-energised the engine can start and run when it is turned by the associated starter motor. Two electro-pneumatic valves (not shown) are provided to control through pneumatically operated pistons, the direction of propulsion of each car by its engines. When the forward electro-pneumatic valve is energised the engines are coupled to the wheels to drive the car forward, and when the reverse electro-pneumatic valve is energised the engines are coupled to the wheels to drive the car in reverse. Those valves are controlled through forward and reverse relays 51 and 52 respectively. The operating coil of the forward relay 51 is connected between the "train negative" line 37 and the "forward" line 32, and the operating coil of the reverse relay 52 is connected between the "train negative" line 37 and the "reverse" line 38. As shown in Figure 1 a direction selector switch 53 is provided and this has a movable contact 54 which may be connected through a main switch 58 to the "train positive" line 36. The direction switch has an "off" position in which the movable contact 54 is on contact 55, a "forward" position in which the movable contact 54 is on contact 56 and so connects the "train positive" line 36 to the "forward" line 32, and a "reverse" position in which the movable contact 54 is on contact 57 and so connects the "train positive" line to the "reverse" line 38. The movable contact 59 of the main switch 58 is ganged to the movable contact 54 of the direction selector switch 53, and the main switch connects the "train positive" line 36 to the contact 54, and also to a line 61, when the direction selector is in either its forward or reverse position. Two indicator lamps 62, 63 are connected to the line 61 and to the "oil indicator 1" and "oil indicator 2" lines respectively.

The apparatus carried by the car also includes "start" relays 64, 65, "stop" relays 66, 67 (in the case of Figures 1 and 2 only), "start isolation relays" 68, 69, a "train stop" relay 71, a "train stop" push-button switch 72, a "train start 1" push-button switch 73 (constituting common start switch means as aforesaid), a "train start 2" push-button switch 74, "local stop" push-button switches 75, 76, and "local start" push-button switches 77, 78.

In addition in the circuits shown in Figures 1 and 2 two sets of contacts 81, 82 and 83, 84 are provided the first set of which is adapted to close when the lubricating oil pressure of engine No. 1 is at or above the pressure which it reaches when running, and the other set of which contacts is adapted to close when the oil pressure of engine No. 2 reaches such a value. In the circuits shown in all three of the Figures there are provided contacts 85, 86, associated respectively with the two engines which contacts are adapted to remain closed so long as the level of the cooling water of the engines is above a critical minimum value. If the water level of one of the engines falls below that value the appropriate contacts 85 or 86 open.

The various elements of the circuits are shown in the condition which they have when the engines are running normally to drive the train forward.

The operation of the circuit shown in Figure 1 is as follows. Assuming that the train is stationary and it is desired to start the engines to drive the train forward, the first operation is to move the ganged contacts 54, 59 of the main switch 58 and direction selector switch 53 to the positions indicated in Figure 1. The consequent connection of the "forward" line 32 to the "train positive" line 36 energises the coil of the forward relay 51 on each car, closing contacts 87 and 88. The closing of contact 87 causes the engines to be coupled to the wheels ready for the train

to be driven forward. The closing of contacts 86 connects the positive terminal 89 of the local battery 41 to the shut down solenoids 48, 49 through the closed contacts 91, 92 of the stop relays 66, 67. The engines of all the cars are thus put into shut down condition. The "train start 1" button 73 is then pressed and the consequent connection of the "start 1" line 53 to the "train positive" line 36 energises the coil of the "start 1" relay 64 through the closed contacts 93 of "start isolation 1" relay 68, thereby closing contacts 94 and 95 and opening contacts 96. The closing of contacts 95 connects the coil of stop 1 relay 66 between the positive and negative terminals 89, 97 of the local battery 41, through the closed contacts 98 of the "train stop" relay 71. The contacts 91 therefore open and de-energise the shut-down solenoid 48 so that the engine No. 1 of each car is set to a condition ready to be started. The closing of contacts 94 of the "start 1" relay 64 connects the positive terminal of the local battery 41 to the starter motor 42, thereby energising it to turn the engine No. 1. Thus the engine No. 1 on each car starts to run, provided that it is in proper working order.

The opening of contacts 96 on the "start 1" relay 64 breaks the energising circuit of the coil of the "start isolation 1" relay 68 to ensure that the "start isolation 1" relay cannot be energised while the "start 1" button is operated. While the "train start 1" button 73 is maintained pressed the oil pressure of engine No. 1 on each car increases until it reaches its proper running value, whereupon the contacts 81, 82 close. The closing of contacts 81 connects the "oil indicator 1" line 34, to the "train negative" line 37 thereby lighting the indicator lamp 62 on each car, to provide an indication that engine No. 1 of the particular car whose circuit is shown in Figure 1 is running. The closing of contacts 82 provides an additional connection, through contacts 85, from the negative terminal 97 of the local battery 41 to the coil of the "stop 1" relay 66, duplicating the similar feed thereto through the "start 1" relay contacts 95, so that the "stop 1" relay 66 remains operated even when the "start 1" relay subsequently becomes unoperated as about to be described.

When the "train start 1" button 73 is released the "start 1" relay 64 on each car becomes unoperated, thereby opening contacts 94 to de-energise the starter 42, opening contacts 95, and closing contacts 96 to connect the coil of the "start isolation 1" relay 68 to the negative terminal 97 of the local battery 41 through the closed oil pressure contacts 82 and the closed water level contacts 85. The contacts 93 of relay 68 are thus opened, so that even if the "train start 1" button 73 is pressed again while the engine No. 1 associated with that particular relay 68 is running (e.g. in order to try again to start the engine No. 1 on another car which may have failed to start on the first depression of button 73) the "start 1" relay associated with that particular relay 68 will not operate and consequently the starter motor 42 of an engine which is already running will not be energised.

The sequence of events on pressing the "train start 2" press button switch 74 to start the engines No. 2 of the train is analogous to that which follows the pressing of the "train start 1" button 73 and consequently will not be described separately.

When it is desired to run the train in reverse the direction selector switch 53 is set so that the contact 54 is on contact 57 instead of on contact 56 and in that case the reverse relay 52 is energised instead of the forward relay 51. The contacts 99 then fulfil a similar function to the contacts 88, and the contacts 101 serve to energise the reverse electropneumatic valve instead of the forward electropneumatic valve.

When it is desired to stop all of the engines of the train the "train stop" button 72 is pressed, thereby energising the "train stop" relay 71 on each car, through the "stop" line 31. The contacts 98 are thereby opened, so breaking the energising circuits of "stop" relays 66, 67. The contacts 91, 92 therefore close to energise the shut-down solenoids 48, 49, thereby stopping both engines on each car.

Either engine on any individual car may be stopped independently of the train control, by pressing the appropriate "local stop" switch button 75 or 76, thereby to energise the shut down solenoid 48 or 49 without using "train stop" relay 71, "stop 1" relay 66, or "stop 2" relay 67.

Either engine on each individual car may be started independently of the train control, by pressing the appropriate "local start" switch button 77 or 78. These "local start" buttons have normally closed contacts 102, which are connected respectively in series between the "start 1" and "start 2" lines 33, 39, and the contacts 93 of the "start isolation" relays 68, 69 and the coils of the "start" relays 64, 65, and normally open contacts 104 which are connected in series between the "train +" line 36 and the contacts 93 of the "start isolation" relays 68, 69 and the coils of the "start" relays 64, 65. When the "local start" button 77 or 78 is pressed the contacts 108 are thereby closed to energise the appropriate "start" relay 64 or 65 and the starter motor of the appropriate engine, provided that the "train +" line 36 is energised, and that the appropriate "start isolation" relay 68 or 69 is unenergised. The opening of the contacts 106 when a "local start" button is pressed, prevents energisation of the "start 1" line 33 or "start 2" line 39 by pressing of a "local start" button. If the appropriate engine is

already running when its "local start" button is pressed, the associated "start isolation" relay is unenergised and consequently the relevant starter motor is not energised.

In the event of the oil pressure or water level of an engine falling below its proper value the appropriate contacts 82, 84 or 85 or 86 open, thereby de-energising the appropriate stop relay 66 or 67 thus energising the shut down solenoid 48 or 49 to stop the engine. Also on the occurrence of low oil pressure the contacts 81 or 83 open so that the appropriate lamp 62 or 63 is extinguished.

In the circuit shown in Figure 2 the contacts 96 omitted from the "start" relays 64, 65 and the coils of the "start isolation" relays are switched by contacts 102, 103 of engine speed relays 104, 105. These relays have their coils directly or indirectly connected respectively to tachometer generators driven by the two engines of the car. When engine No. 1 (for example) reaches a predetermined moving speed its generator causes the associated engine speed relay 104 to operate, thereby energising the "start isolation 1" relay 68 to open its contacts 93 for the above described purpose.

In the circuit shown in Figure 3, the oil pressure contacts 81—84, and the contacts 95 and 96 of the "start" relays 64, 65 are omitted. Engine speed relays are provided as in Figure 2. Stop relays 66, 67 are also omitted and the train stop relay is provided with two sets of contacts 106, 107 which serve to energise the shut down solenoids 48, 49 from the local battery 41 when the "train stop" button 72 is pressed. The water level contacts 85, 86 are in this Figure, open when the water level is satisfactory. When those contacts 85, 86 close they serve to energise the shut down solenoids to stop the engines.

A switch (not shown) is provided to isolate the starter of any one engine, from the local battery and "start 1" or "start 2" lines when desired. The operation of "train start 1" or "train start 2" buttons or "local start 1" or "local start 2" buttons, will not affect an engine so isolated.

In each case each position from which the train may be controlled is equipped with a separate oil indicator lamp (such as 62, 63) for each engine of the whole train, an air and direction indicator lamp for each car (indicating that the engines on each car are coupled to drive it in the direction selected), a gear control unit comprising (a) means for changing the gear ratio of the coupling between the engines and their car wheels—four alternative gear ratios being provided for, and each gear ratio having a control line running the length of the train, and (b) a direction selector switch 53 and a main switch 58 as previously described. This switch is also ganged to operate further switches which only allow oil indication lamps to indicate at a driving position from which the train is controlled at any one time, and isolates the throttle controls (mentioned below) at driving positions not being used. There are also provided at each control position a throttle control for setting the throttles of all of the engines of the train—four alternative settings being provided for and each setting having a control line running the length of the train—, a combined 'deadmans' control and emergency valve for stopping the train in an emergency and connected to a 'deadmans' control line running the length of the train, and a passenger communication cancellation valve (for temporarily overriding an emergency brake application) operated by a press button.

The circuits shown in Figures 1, 2 and 3 are particularly applicable to multi-unit trains employing diesel engines with mechanical transmission.

The train may include additional cars not provided with engines, and such additional cars may be interposed between the diesel-engine powered cars or may be equipped with positions for controlling the train, connectors being provided at each end of such additional cars and being linked by lines extending along those cars.

The invention is not restricted to the details of the foregoing examples. For instance additional contacts may be provided for stopping any engine if its cooling water or lubricating oil temperature exceeds a safe value, or if an engine exceeds its safe running speed, or if a fire detection system detects a fire in an engine. Two starter motors, connected for energization simultaneously, may be provided for each engine.

WHAT WE CLAIM IS:—

1. Apparatus for controlling a plurality of internal combustion engines, which apparatus comprises a plurality of start relays associated respectively with the engines and each connected to a common supply line, at least one starter motor for each engine, the energising circuits for the starter motors each being controlled directly or indirectly by the associated start relay, and a common start switch means for controlling connection of the common supply line to a source of power, the arrangement being such that on operation of the common start switch means the relays cause energisation of the respective starter motors to turn the respective engines.

2. Apparatus as claimed in claim 1 arranged for controlling a plurality of engines mounted respectively on a plurality of cars, carriages, trucks or vans of a train, in which the said common supply line extends along the train.

3. Apparatus as claimed in claim 1, or claim 2 in which the relays are electrical relays the starter motors are electrical starter motors and the said source is a source of electric power.

4. Apparatus as claimed in any one of the preceding claims, including means for giving

to a person operating the common start switch means an indication of whether or not each individual engine is running.

5. Apparatus as claimed in claim 4, in which the said means for giving an indication comprises for each engine an indicator lamp controlled by switch means responsive to engine oil pressure, engine speed or other condition dependent upon running of the engine.

6. Apparatus as claimed in any one of the preceding claims, including means for preventing energisation of the starter motor, or to prevent coupling between the engine and the starter motor, of any engine which is already running when the common start switch means is operated.

7. Apparatus as claimed in claim 6, in which means are also provided for de-energising the starter motor, or for decoupling from the engine the starter motor, of each engine when that engine starts to run.

8. Apparatus as claimed in any one of the preceding claims, including common stop control means for stopping all of the engines from a single control position.

9. Apparatus as claimed in claim 8, in which the common stop control means comprises a plurality of common stop relays associated respectively with the engines and each connected to a common supply line, a plurality of fuel cut-off means for cutting off the fuel supplies to the respective engines, which fuel cut-off means are each respectively controlled directly or indirectly by the associated common stop relay, and common stop switch means for controlling connection of the common stop supply line to a source of power, the arrangement being such that on operation of the common stop switch means, the common stop relays directly or indirectly cause the fuel cut-off means to cut off the fuel supplies to the engines.

10. Apparatus as claimed in claim 2 and claim 9 in which there are a plurality of engines on at least one car, carriage, truck or van and one common stop relay is associated with those engines thereon.

11. Apparatus as claimed in claim 9 or claim 10, in which the common start switch means and the common stop switch means are provided at a common control position.

12. Apparatus as claimed in claim 11, arranged so that there are a plurality of common control positions as aforesaid each having common start switch means and common stop switch means.

13. Apparatus as claimed in any one of the preceding claims, including means for starting and stopping each engine individually irrespective of the common start and stop controls.

14. Apparatus as claimed in any one of the preceding claims including means responsive to an abnormal running condition of each engine, for stopping that engine if such abnormal condition occurs.

15. Apparatus for controlling a plurality of internal combustion engines substantially as hereinbefore described with reference to, and illustrated diagrammatically in, Figure 1 or Figure 2, or Figure 3 of the accompanying drawings.

BOULT, WADE & TENNANT,
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PROVISIONAL SPECIFICATION

Improvements in or relating to Control Apparatus for Internal Combustion Engines

We, BRITISH UNITED TRACTION LIMITED, a British Company, of Hanover House, 14, Hanover Square, London, W.1, and GEOFFREY HAROLD PASSEY, a British Subject, of 4, St. George's Drive, Ickenham, Middlesex, do hereby declare this invention to be described in the following statement:—

The invention relates to control apparatus for internal combustion engines and it is an object of the invention to provide improved control apparatus for that purpose.

The invention provides, in one of its aspects, apparatus for controlling a plurality of internal combustion engines, which apparatus comprises a plurality of relays (hereinafter referred to as start relays) associated respectively with the engines and each connected to a common supply line, a starter motor for each engine, the energising circuits for the starter motors each being controlled directly or indirectly by the associated start relay, and switch means (hereinafter referred to as common start switch means) for controlling connection of the common supply line to a source of power, the arrangement being such that on operation of the common start switch means the relays cause energisation of the respective starter motors to turn the respective engines. The engines can thus all be started from a single control position at which common start switch means as aforesaid (e.g. a push-button switch) are provided.

In a preferred form of the invention a plurality of engines are mounted respectively on a plurality of cars, carriages, trucks or vans of a train (e.g. a railway train) and the said common supply line extends along the train. The relays are preferably electrical relays, starter motors are preferably electrical starter motors and the said source is preferably a source of electric power.

Means are preferably provided for giving

to a person operating the common start switch means an indication of whether or not each individual engine is running. Such means may comprise for each engine an indicator lamp controlled by switch means responsive to engine oil pressure, engine speed or other condition dependent upon running of the engine.

Preferably means are provided to prevent energisation of the starter motor, or to prevent coupling between the engine and the starter motor, of any engine which is already running when the common start switch means is operated. Preferably means are also provided for de-energising the starter motor, or for de-coupling from the engine the starter motor, of each engine when that engine starts to run.

Common stop control means are preferably provided for stopping all of the engines from a single control position. The common stop control means preferably comprise a plurality of relays (hereinafter referred to as train stop relays) associated respectively with the engines and each connected to a common supply line, a plurality of fuel cut-off means for cutting off the fuel supplies to the respective engines, which fuel cut-off means are each respectively controlled directly or indirectly by the associated train stop relay, and switch means (hereinafter referred to as common stop switch means) for controlling connection of the stop common supply line to a source of power, the arrangement being such that on operation of the common stop switch means the train stop relays directly or indirectly cause the fuel cut off means to cut off the fuel supplies to the engines. The common start switch means and the common stop switch means are preferably provided at a common control position. A plurality of such common control positions, each having common start switch means and common stop switch means, may be provided e.g. on each car of a train.

Means are preferably provided for starting and stopping each engine individually irrespective of the common start and stop controls. Means responsive to an abnormal running condition of each engine (e.g. low oil pressure, low water level, or fire) may be provided for stopping that engine if such abnormal condition occurs.

Some specific constructions of apparatus embodying the invention will now be described by way of example and with reference to the accompanying drawings, in which:—

Figures 1, 2 and 3 are respective circuit diagrams of three forms of apparatus for controlling diesel engines providing motive power for a railway train.

In these examples the train comprises up to six cars each of which carries two diesel engines (referred to for convenience as the No. 1 and No. 2 engine respectively of each car). Each of the Figures shows the circuit of one car.

Each car has multi pole connectors at each end, the poles of which are connected to the corresponding poles of the connectors on the adjacent cars when the train is made up. Common lines extend along each car from the poles of the connector at one end to poles of the connector at the other end, and nine of those lines are shown at 31—39 in each of the Figures of the drawings.

Each car has a battery, 41, capable of providing sufficient power to energise electric starter motors 42 and 43, associated respectively with the two diesel engines (not shown). Any one of these batteries may additionally be coupled by switch means (not shown) to lines 36 and 37 on that car, so that on every car, lines 36 and 37 are energised. The starter motors 42, 43 have respectively starter switches 44, 45 including a solenoid 46 which when energised closes the heavy switch contacts 47. Each engine has the stopping lever of its fuel pump (not shown) controlled by a shut-down solenoid 48 or 49 which when energised pulls that lever to a position to cut off the fuel supply to the engine so that the engine stops. When the shut down solenoid is de-energised the engine can start and run when it is turned by the associated starter motor. Two electro-pneumatic valves (not shown) are provided to control, through pneumatically operated pistons, the direction of propulsion of each car by its engines. When the forward electro-pneumatic valve is energised the engines are coupled to the wheels to drive the car forward, and when the reverse electro-pneumatic valve is energised the engines are coupled to the wheels to drive the car in reverse. Those valves are controlled through forward and reverse relays 51 and 52 respectively. The operating coil of the forward relay 51 is connected between the "train negative" line 37 and the "forward" line 32, and the operating coil of the reverse relay 52 is connected between the "train negative" line 37 and the "reverse" line 38. As shown in Figure 1 a direction selector switch 53 is provided and this has a movable contact 54 which may be connected through a main switch 58 to the "train positive" line 36. The direction switch has an "off" position in which the movable contact 54 is on contact 55, a "forward" position in which the movable contact 54 is on contact 56 and so connects the "train positive" line 36 to the "forward" line 32, and a "reverse" position in which the movable contact 54 is on contact 57 and so connects the "train positive" line to the "reverse" line 38. The movable contact 59 of the main switch 58 is ganged to the movable contact 54 of the direction selector switch 53, and the main switch connects the "train positive" line 36 to the contact 54, and also to a line 61, when the direction selector is in either its forward or reverse position. Two

indicator lamps 62, 63 are connected to the line 61 and to the "oil indicator 1" and "oil indicator 2" lines respectively.

The apparatus carried by the car also includes "start" relays 64, 65, "stop" relays 66, 67 (in the case of Figures 1 and 2 only), "start isolation relays" 68, 69, a "train stop" relay 71, a "train stop" push-button switch 72, a "train start 1" push-button switch 73 (constituting common start switch means as aforesaid), a "train start 2" push-button switch 74, "local stop" push-button switches 75, 76, and "local start" push-button switches 77, 78.

In addition in the circuits shown in Figures 1 and 2 two sets of contacts 81, 82 and 83, 84 are provided the first set of which is adapted to close when the lubricating oil pressure of engine No. 1 is at or above the pressure which it reached when running, and the other set of which contacts is adapted to close when the oil pressure of engine No. 2 reaches such a value. In the circuits shown in all three of the Figures there are provided contacts 85, 86, associated respectively with the two engines which contacts are adapted to remain closed so long as the level of the cooling water of the engines is above a critical minimum value. If the water level of one of the engines falls below that value the appropriate contacts 85 or 86 open.

The various elements of the circuits are shown in the condition which they have when the engines are running normally to drive the train forward.

The operation of the circuit shown in Figure 1 is as follows. Assuming that the train is stationary and it is desired to start the engines to drive the train forward, the first operation is to move the ganged contacts 54, 59 of the main switch 58 and direction selector switch 53 to the positions indicated in Figure 1. The consequent connection of the "forward" line 32 to the "train positive" line 36 energises the coil of the forward relay 51 on each car, closing contacts 87 and 88. The closing of contact 87 causes the engines to be coupled to the wheels ready for the train to be driven forward. The closing of contacts 86 connects the positive terminal 89 of the local battery 41 to the shut down solenoids 48, 49 through the closed contacts 91, 92 of the stop relays 66, 67. The engines of all the cars are thus put into shut down condition. The "train start 1" button 73 is then pressed and the consequent connection of the "start 1" 33 line to the "train positive" line 36 energises the coil of the "start 1" relay 64 through the closed contacts 93 of "start isolation 1" relay 68, thereby closing contacts 94 and 95 and opening contacts 96. The closing of contacts 95 connects the coil of stop 1 relay 66 between the positive and negative terminals 89, 97 of the local battery 41, through the closed contacts 98 of the "train stop" relay 71. The contacts 91 therefore open and de-energise the shut-down solenoid 48 so that the engine No. 1 of each car is set to a condition ready to be started. The closing of contacts 94 of the "start 1" relay 64 connects the positive terminal of the local battery 41 to the solenoid 46 of the starter switch 44 thereby energising it to cause the main starter switch contacts 47 to close, thus energising the starter motor 42 to turn the engine No. 1. Thus the engine No. 1 on each car starts to run, provided that it is in proper working order.

The opening of contacts 96 on the "start 1" relay 64 breaks the energising circuit of the coil of the "start isolation 1" relay 68 to ensure that the "start isolation 1" relay cannot be energised while the "start 1" relay is operated. While the "train start 1" button 73 is maintained pressed the oil pressure of engine No. 1 on each car increases until it reaches its proper running value, whereupon the contacts 81, 82 close. The closing of contacts 81 connects the "oil indicator 1" line 34 to the "train negative" line 37 thereby lighting the indicator lamp 62 on each car, to provide an indication that engine No. 1 of the particular car whose circuit is shown in Figure 1 is running. The closing of contacts 82 provides an additional connection, through contacts 85, from the negative terminal 97 of the local battery 41 to the coil of the "stop 1" relay 66, duplicating the similar feed thereto through the "start 1" relay contacts 95, so that the "stop 1" relay 66 remains operated even when the "start 1" relay subsequently becomes unoperated as about to be described.

When the "train start 1" button 73 is released the "start 1" relay 64 on each car becomes unoperated, thereby opening contacts 94 to de-energise the starter 42, opening contacts 95, and closing contacts 96 to connect the coil of the "start isolation 1" relay 93 to the negative terminal 97 of the local battery 41 through the closed oil pressure contacts 82 and the closed water level contacts 85. The contacts 93 are thus opened, so that even if the "train start 1" button 73 is pressed again while the engine No. 1 associated with that particular relay 68 is running (e.g. in order to try again to start the engine No. 1 on another car which may have failed to start on the first depression of button 73) the "start 1" relay associated with that particular relay 68 will not operate and consequently the starter motor 42 of an engine which is already running will not be energised.

The sequence of events on pressing the "train start 2" press button switch 74 to start the engines No. 2 of the train is analogous to that which follows the pressing of the "train start 1" button 73 and consequently will not be described separately.

When it is desired to run the train in reverse the train selector switch 53 is set so that the contact 54 is on contact 57 instead

of on contact 56 and in that case the reverse relay 52 is energised instead of the forward relay 51. The contacts 99 then fulfil a similar function to the contacts 88, and the contacts 101 serve to energise the reverse electro-pneumatic valve instead of the forward electro-pneumatic valve.

When it is desired to stop all of the engines of the train the "train stop" button 72 is pressed, thereby energising the "train stop" relay 71 on each car, through the "stop" line 31. The contacts 98 are thereby opened, so breaking the energising circuits of "stop" relays 66, 67. The contacts 91, 92 therefore close to energise the shut-down solenoids 48, 49, thereby stopping both engines on each car.

Either engine on any individual car may be started or stopped independently of the train control, by pressing the appropriate "local start" switch button 77 or 78, thereby to energise the starter motor 42 or 43 through the associated starter switch 44 or 45, or by pressing the appropriate "local stop" switch button 75 or 76, thereby to energise the shut down solenoid 48 or 49 without using "start 1" relay 64, "start 2" relay 65, "train stop" relay 71, "stop 1" relay 66, or "stop 2" relay 67.

In the event of the oil pressure or water level of an engine falling below its proper value the appropriate contacts 82, 84 or 85 or 86 open, thereby de-energising the appropriate stop relay 66 or 67 thus energising the shut down solenoid 48 or 49 to stop the engine. Also on the occurrence of low oil pressure the contacts 81 or 83 open so that the appropriate lamp 62 or 63 is extinguished.

In the circuit shown in Figure 2 the contacts 96 are omitted from the "start" relays 64, 65 and the coils of the "start isolation" relays are switched by contacts 102, 103 of engine speed relays 104, 105. These relays have their coils directly or indirectly connected respectively to tachometer generators driven by the two engines of the car. When engine No. 1 (for example) reaches a predetermined moving speed its generator causes the associated engine speed relay 104 to operate, thereby energising the "start isolation 1" relay 68 to open its contacts 93 for the above described purpose.

In the circuit shown in Figure 3, the oil pressure contacts 81—84, and the contacts 95 and 96 of the "start" relays 64, 65 are omitted. Engine speed relays are provided as in Figure 2. Stop relays 66, 67 are also omitted and the train stop relay is provided with two sets of contacts 106, 107 which serve to energise the shut down solenoids 48, 49 from the local battery 41 when the "train stop" button 72 is pressed. The water level contacts 85, 86 are in this Figure, open when the water level is satisfactory. When those contacts 85, 86 close they serve to energise the shut down solenoids to stop the engines.

A switch (not shown) is provided to isolate the starter and starter switch, of any one engine, from the local battery and "start 1" or "start 2" lines. The operation of "train start 1" or "train start 2" buttons or "local start 1" or "local start 2" buttons, will not affect an engine so isolated.

In each case each position from which the train may be controlled is equipped with a separate oil indicator lamp (such as 62, 63) for each engine of the whole train, an air and directions indicator lamp for each car (indicating that the engines on each car are coupled to drive it in the direction selected), a gear control unit comprising (a) means for changing the gear ratio of the coupling between the engines and their car wheels—four alternative gear ratios being provided for, and each gear ratio having a control line running the length of the train, and (b) a direction selector switch 53 and a main switch 58 as previously described. This switch is also ganged to operate further switches which only allow oil indication lamps and air and direction indicator lamps to indicate at a driving position from which the train is controlled at any one time, and isolates the throttle controls (mentioned below) at driving positions not being used. A throttle control for setting the throttle of all of the engines of the train—four alternative settings being provided for and each setting having a control line running the length of the train—, a combined 'deadmans' control and emergency valve for stopping the train in an emergency and connected to a 'deadman' control line running the length of the train, and a passenger communication cancellation valve (for temporarily overriding an emergency brake application) operated by a press button.

The circuits shown in Figures 1, 2, 3 are particularly applicable to trains employing diesel engines with mechanical transmission for use as multi-unit trains.

The train may include additional cars not provided with engines, and such additional cars may be interposed between the diesel-engine powered cars or may be equipped with positions for controlling the train, connectors being provided at each end of such additional cars and being linked by lines extending along those cars.

The invention is not restricted to the details of the foregoing examples. For instance additional contacts may be provided for stopping

any engine if its cooling water or lubricating oil temperature exceeds a safe value, or an engine exceeds its safe running speed.

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Chartered Patent Agents.

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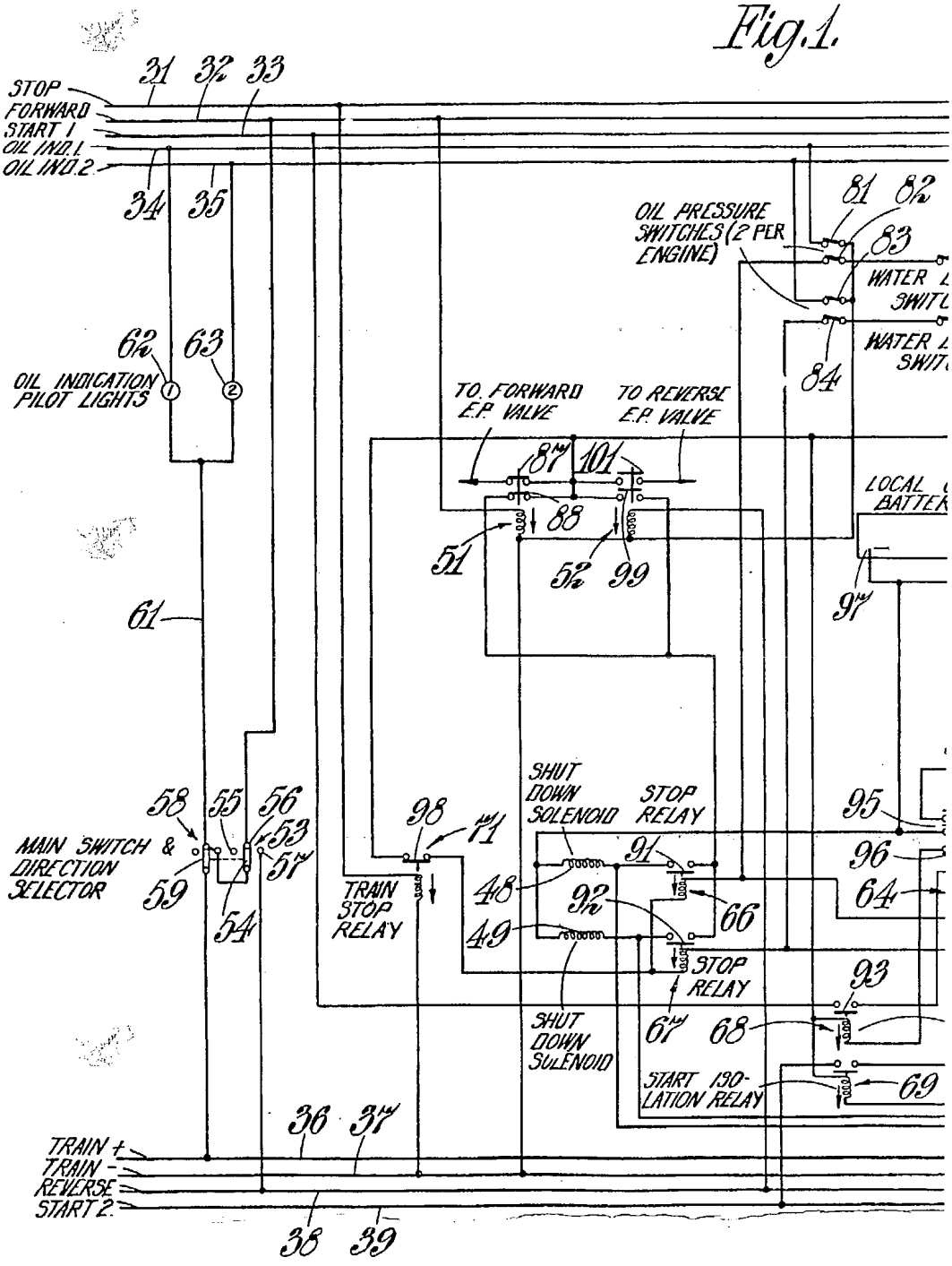
Published by The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

Fig. 1.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FORWARD
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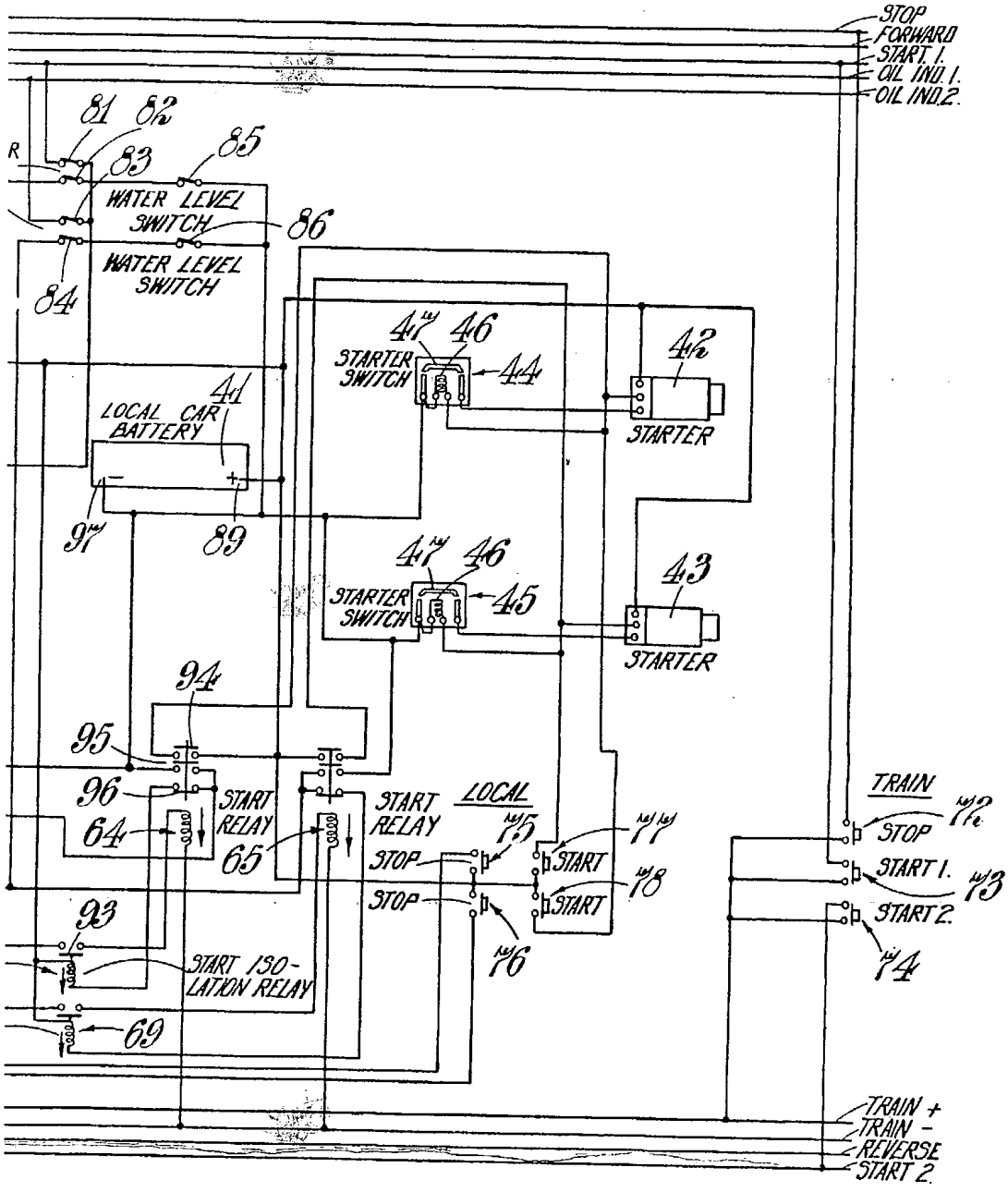
OIL IND. 2
31
32
33
34
35
62
63
OIL INDICATION PILOT LIGHTS
61
OIL PRESSURE SWITCHES (2 PER ENGINE)
81
82
83
84
WATER
SWIT
TO FORWARD E.P. VALVE
TO REVERSE E.P. VALVE
87
101
88
51
52
99
LOCAL
BATTER
97
58
55
56
53
57
59
54
MAIN SWITCH & DIRECTION SELECTOR
98
71
TRAIN STOP RELAY
SHUT DOWN SOLENOID
STOP RELAY
91
48
92
66
49
95
96
64
93
67
68
SHUT DOWN SOLENOID
START ISOLATION RELAY
69
36
37
TRAIN +
TRAIN -
REVERSE
START 2
38
39

808657
3 SHEETS

PROVISIONAL SPECIFICATION
This drawing is a reproduction of the Original on a reduced scale
Sheet 1

Fig. 1.



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3 SHEETS

PROVISIONAL SPECIFICATION
This drawing is a reproduction of the Original on a reduced scale
Sheet 1

Fig. 1.

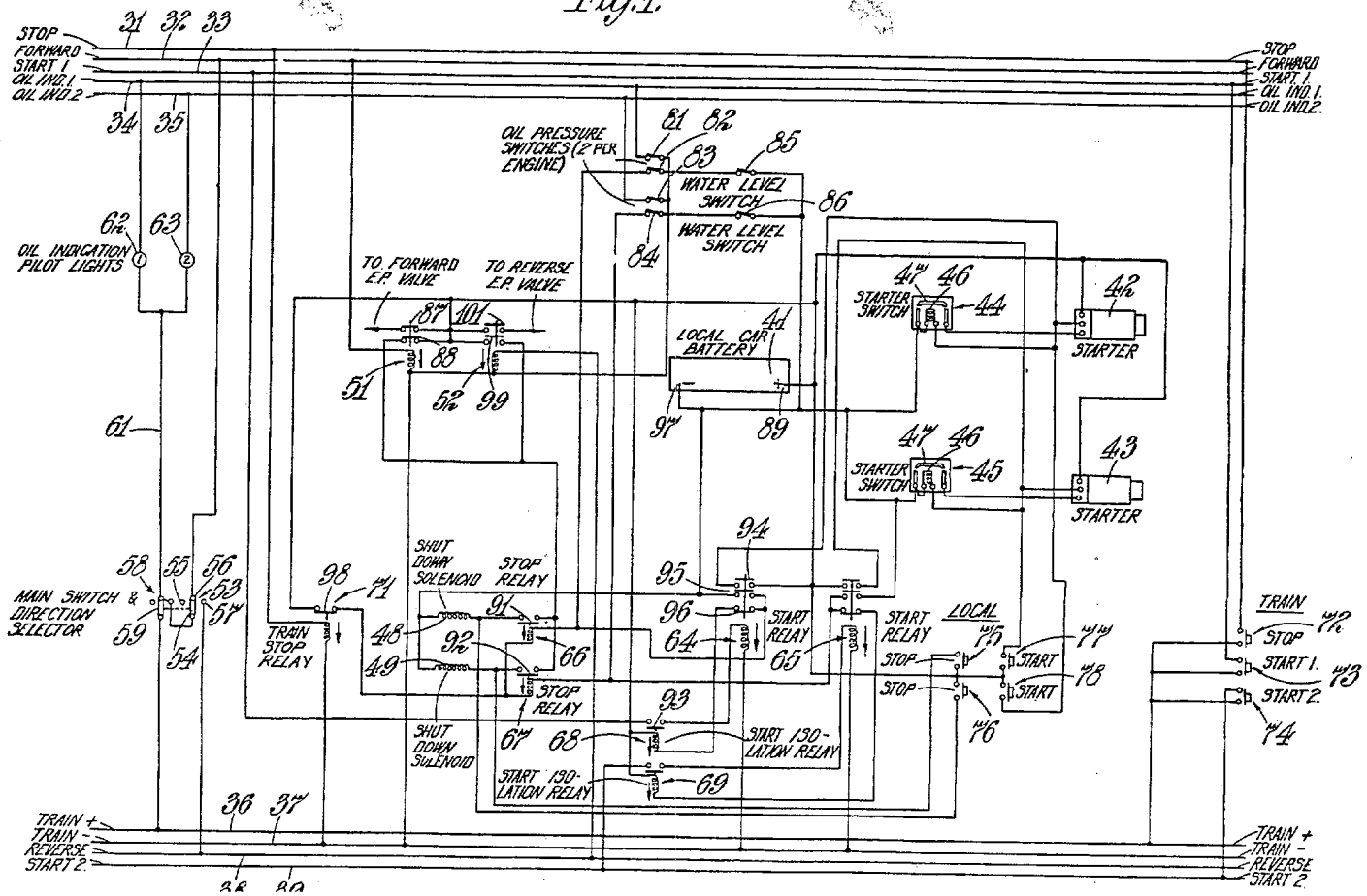
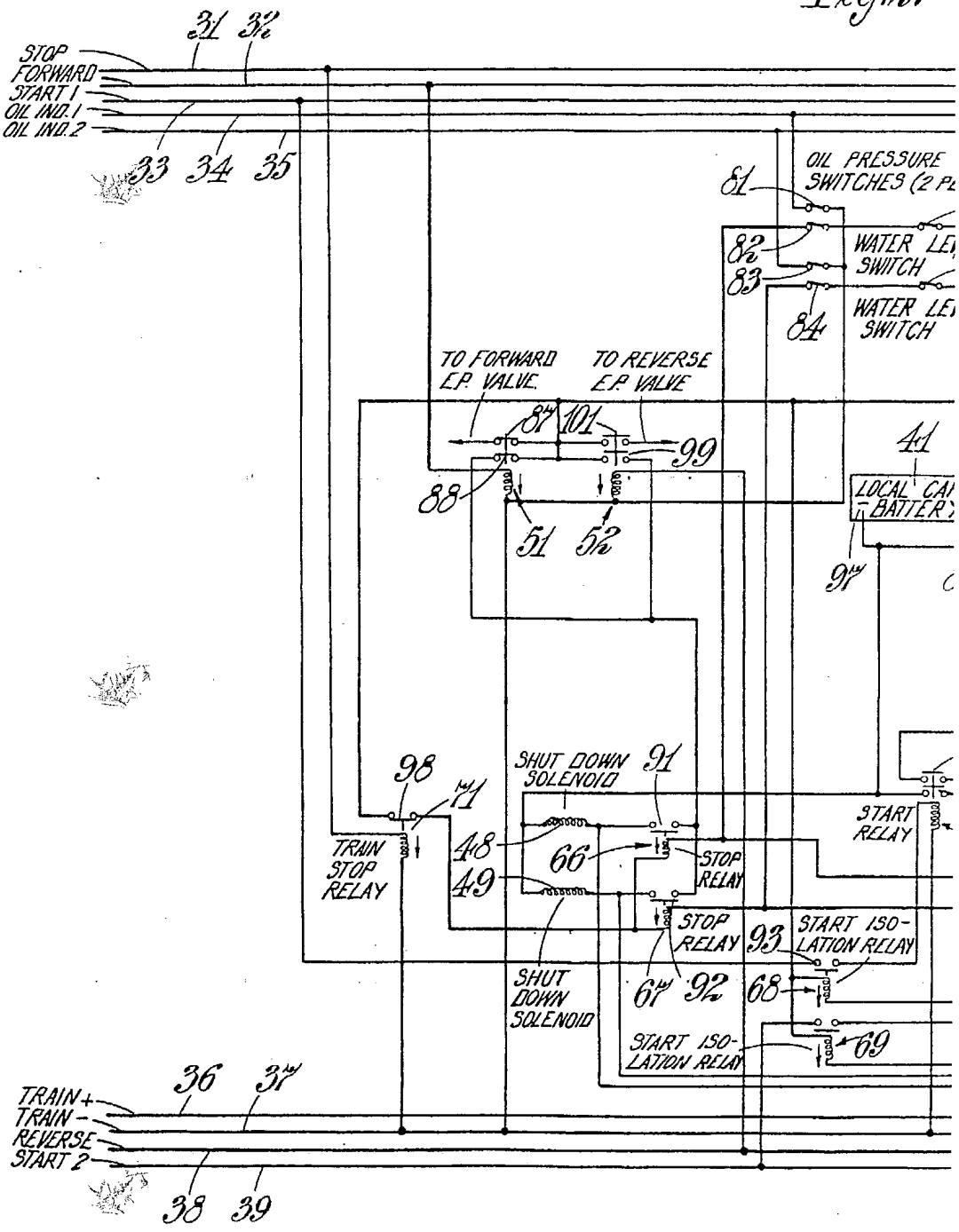


Fig. 2.


STOP
FORWARD
START 1
OIL IND. 1
OIL IND. 2
31
32
33
34
35
OIL PRESSURE SWITCHES (2 PL
81
82
WATER LE SWITCH
83
84
WATER LE SWITCH
TO FORWARD E.P. VALVE
TO REVERSE E.P. VALVE
87
101
99
88
51
52
41
LOCAL CA - BATTER
97
98
71
SHUT DOWN SOLENOID
91
START RELAY
TRAIN STOP RELAY
48
49
66
STOP RELAY
STOP RELAY
93
START ISO-LATION RELAY
SHUT DOWN SOLENOID
67
92
68
START ISO-LATION RELAY
69
TRAIN +
TRAIN -
REVERSE
START 2
36
37
38
39

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3 SHEETS

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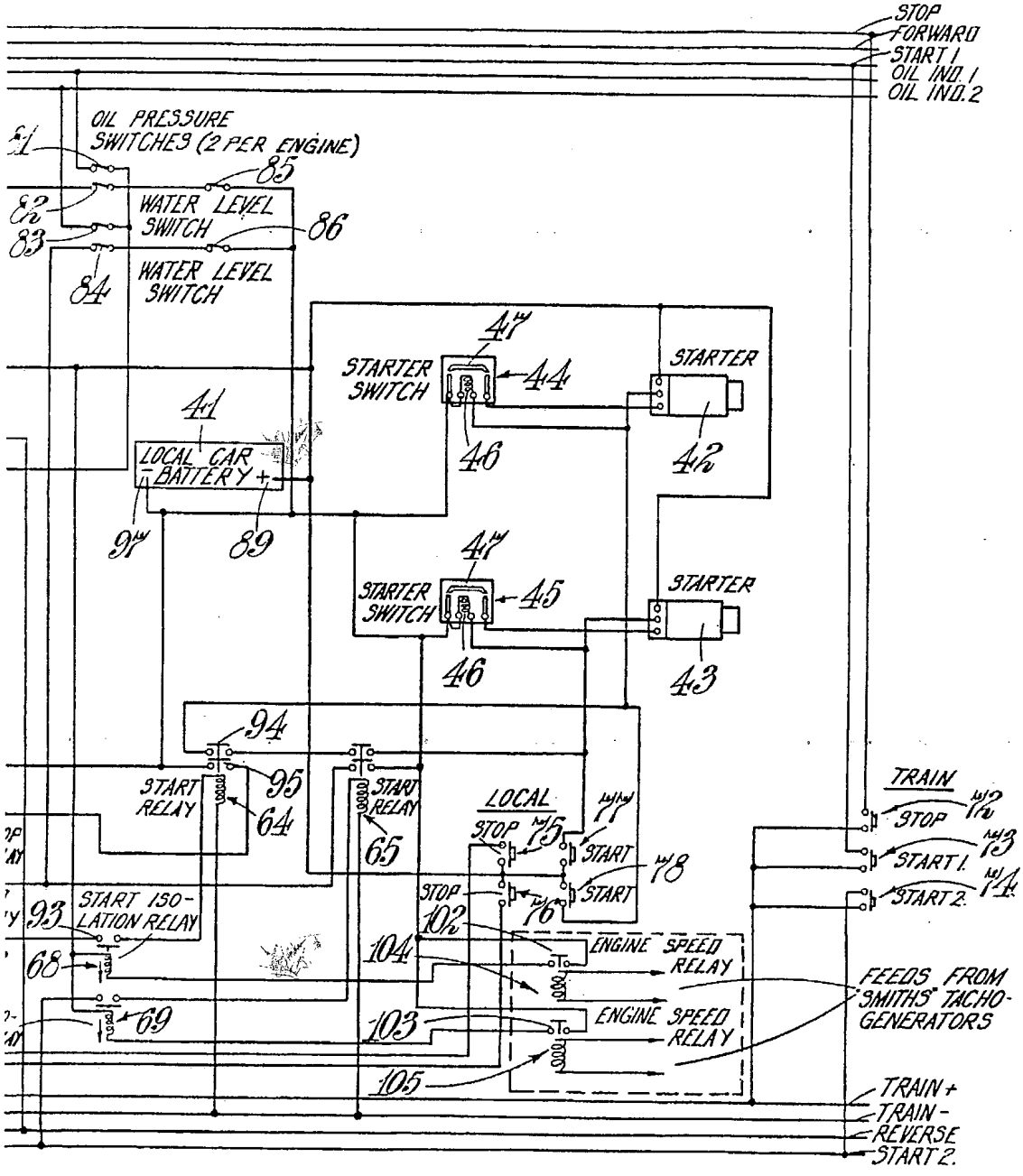
Sheet 2

Fig. 2.



808657 COMPLETE SPECIFICATION
3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

Fig.2.

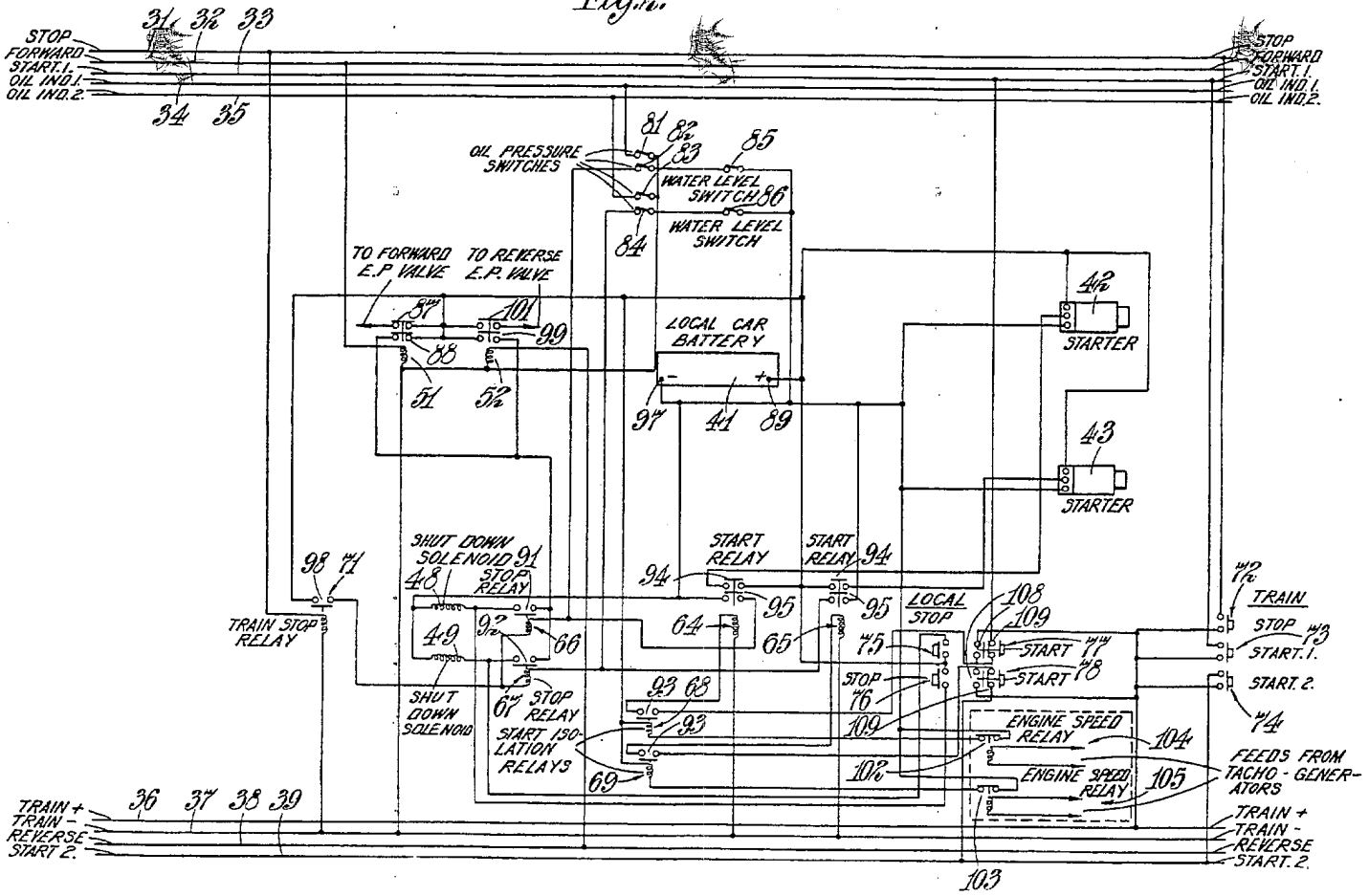
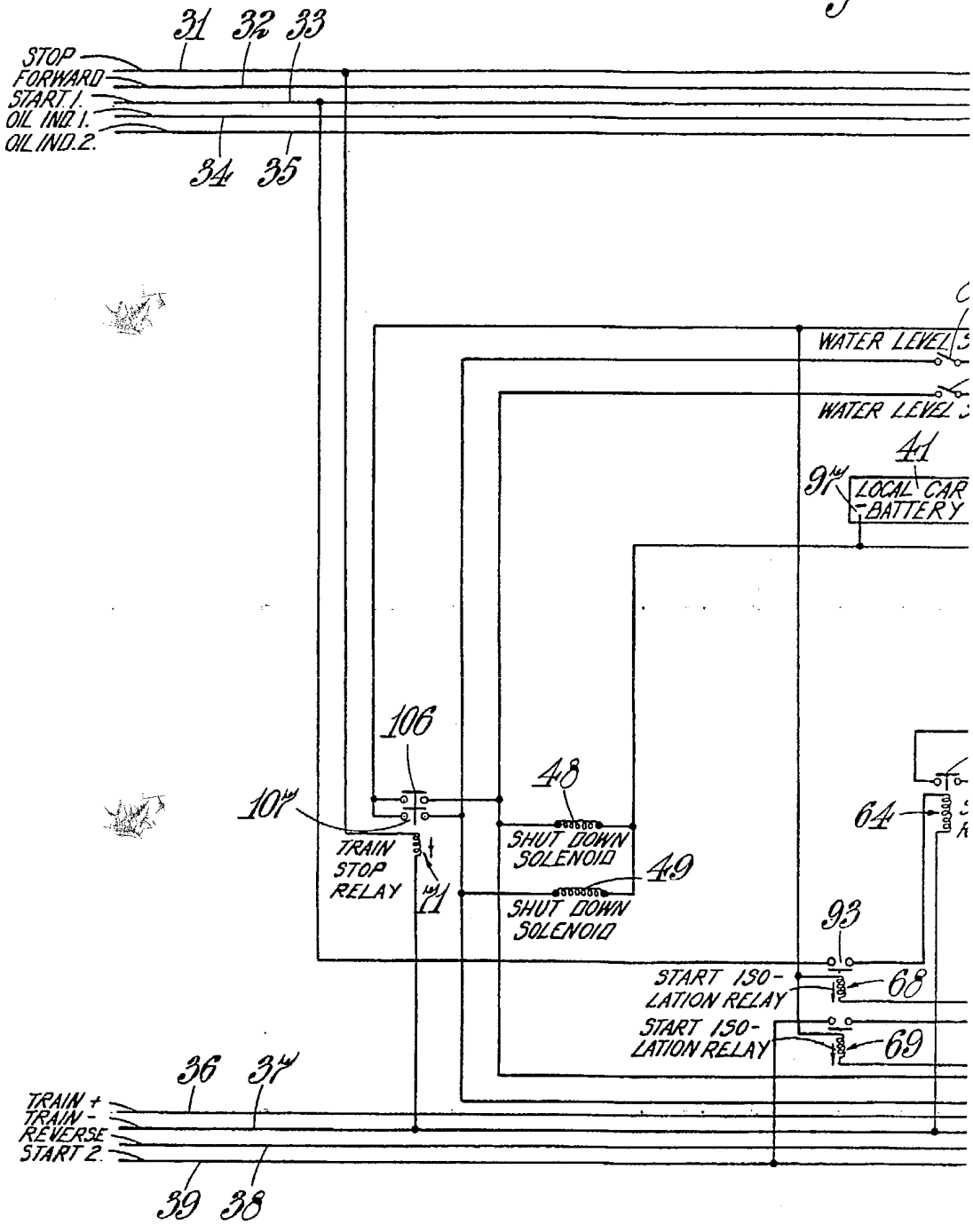


Fig. 3.


31
32
33
STOP
FORWARD
START 1.
OIL IND 1.
OIL IND. 2.
34
35
WATER LEVEL
WATER LEVEL
41
97
LOCAL CAR
BATTERY
106
107
48
TRAIN
STOP
RELAY
71
SHUT DOWN
SOLENOID
49
SHUT DOWN
SOLENOID
64
93
START ISO-
LATION RELAY
68
START ISO-
LATION RELAY
69
36
37
TRAIN +
TRAIN -
REVERSE
START 2.
39
38

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3 SHEETS

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Sheet 3

Fig. 3.

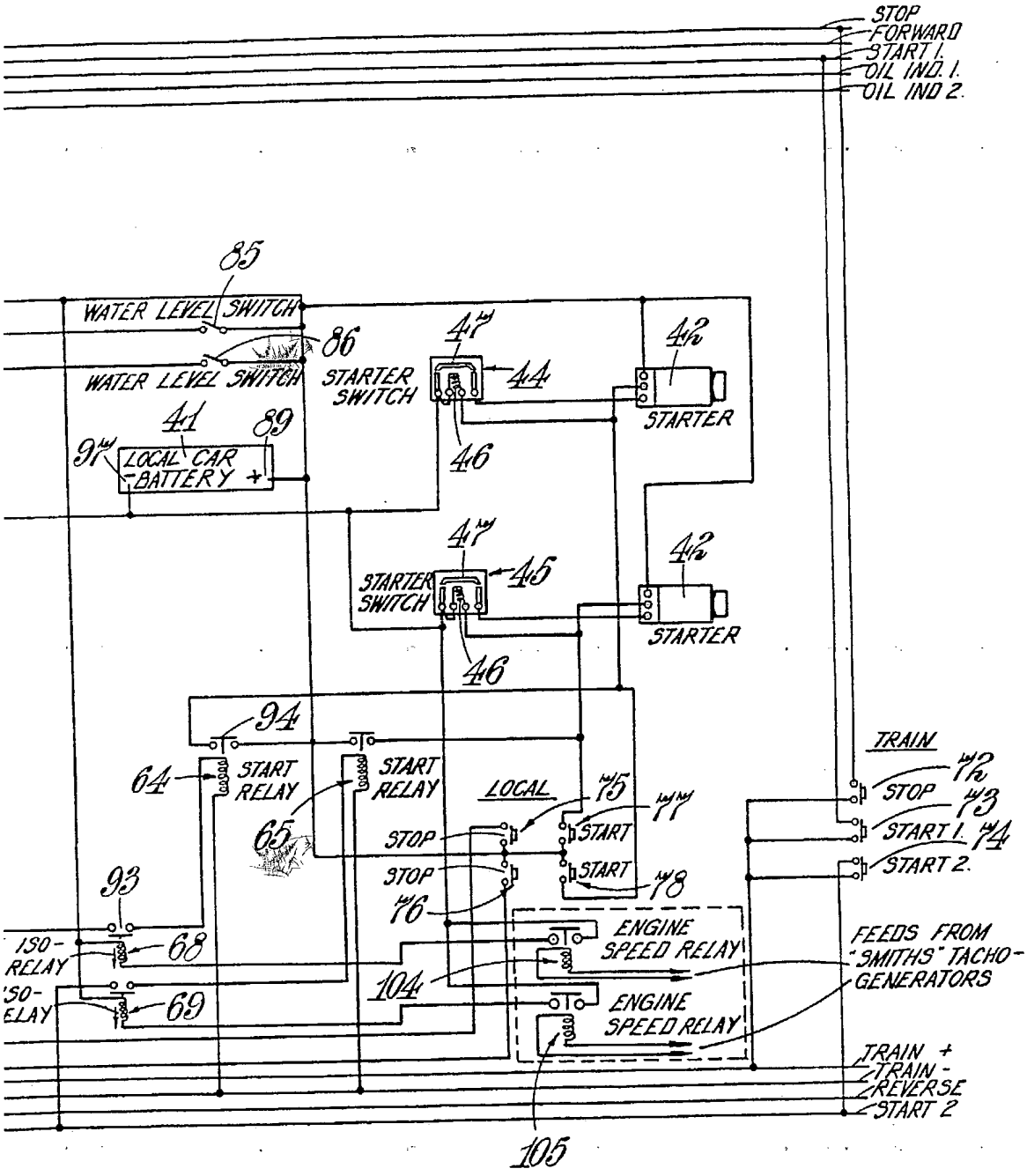

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Fig.3.